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[MHD 8: Dentistry]

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( Reaffirmed 1998 )

# *Indian Standard*

# SPECIFICATION FOR DENTAL CASTING INVESTMENT FOR GOLD ALLOYS

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# *Indian Standard*

## SPECIFICATION FOR DENTAL CASTING INVESTMENT FOR GOLD ALLOYS

## 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 29 August 1974, after the draft finalized by the Dental Materials Sectional Committee had been approved by the Chemical Division Council.

0.2 In the preparation of this standard, assistance has been derived from the following publications:

AS T 22-1963 Dental casting investment. Standards Association of Australia.

ASA Z 93.2-1962 Casting investment for gold alloy. American Standards Association.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

## 1. SCOPE

**1.1** This standard prescribes the requirements and the methods of sampling and tests for dental casting investment for gold alloys. The material is used in casting dental restorations of gold alloy.

## 2. TYPES

**2.1** The investment material shall be of three types, namely:

Type I Inlay, thermal;
Type II Inlay, hygroscopic; and
Type III Partial denture, thermal.

## 3. REQUIREMENTS

**3.1** Description -Dental casting investment shall be a powder composed essentially of a mixture of calcined gypsum and silica with or without the addition of other modifying agents, which, when mixed with water in

*Rules for rounding off numerical values ( *revised* ).

proper ratio, applied to the dental wax pattern, and heated in the usual manner, shall be found satisfactory for use in casting dental gold alloy restorations.

3.2 Uniformity — The material shall be uniform and free from foreign material and set or caked lumps. Colouring material as such shall not be regarded as foreign material.

3.3 Fineness — The fineness of the powder shall be such that a minimum of 85 percent shall pass 75-micron IS Sieve, 95 percent shall pass 150-micron IS Sieve, and 100 percent shall pass 600-micron IS Sieve, when tested as prescribed in A-2.

3.4 Testing Consistency -- The average of the maximum and minimum diameters of the spread of the slumped mixture shall be between 57 and 70 mm for Type I and Type II and between 38 and 41 mm for Type III when tested as specified in A-3.

3.5 Time of Setting -The time of setting shall be not less than 5 nor more than 25 minutes. The time of setting shall not vary by more than 20 percent from the manufacturer's stated values when tested as specified in A-4.

3.6 Compressive Strength — The compressive strength shall be not less than 25 kg/cm² for Type I and Type II and not less than 50 kg/cm² for Type III when tested as prescribed in A-5.

3.7 Setting Expansion and Thermal Expansion — The setting expansion and thermal expansion shall be as given in Table 1.

**TABLE 1 SETTING EXPANSION AND THERMAL EXPANSION**

| SL No. | Type | Setting Expansion (at 2 Hours), Percent | | Thermal Expansion | | Combined Setting and Thermal Expansion, Percent |
|---|---|---|---|---|---|---|
| | | In Air | In Water | Temperature, °C | Expansion, Percent | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| i) | Type I | 0·5, *Max* | — | 700 | 1·0 to 2·0 | 1.3 to 2·0 |
| ii) | Type II | — | 1.2 to 2.2 | 500 | 0.6, *Max* | 1.3 to 2.7 |
| iii) | Type III | 0.4, *Max* | — | 700 | 1·0 to 1.5 | 1.2 to 1·9 |

3.7.1 The values for setting expansion and thermal expansion shall not vary from the manufacturer's stated value ( or from the middle of the range if a range of values is stated ) by more than ±0·1 percent expansion or more than ±20 percent of the stated value, whichever is greater. The thermal expansion specimens shall not, at any temperature within the range of200 to 700°C for Type I and Type III, and 200 to 500°C for Type II, show a length shorter than the original length at room temperature, and shall not at any temperature within this range show a shrinkage or decrease

in length of more than 0·15 percent from the maximum length at any lower temperature.

**3.7.2** Tests for setting expansion and thermal expansion shall be done as prescribed in A-6 and A-7 respectively.

3.8 **Surface Defects of Alloy** — The material shall not contaminate the surface of the alloy cast into it and shall not cause pitting, fins, rough surfaces, or voids in the alloy when tested as prescribed in A-8.

3.9 **Instructions** — Adequate and accurate instructions for proportioning and manipulating shall accompany each unit package. These shall include:

a) Water-to-powder ratio recommended by the manufacturer;

b) Setting time;

c) Setting expansion in air and in water for Type I, Type II and Type III; and

d) Thermal expansion curve.

## 4. PACKING AND MARKING

**4.1 Packing** — The material shall be packed in moisture-resisting containers.

4.2 **Instructions for Use** — Accurate and adequate instructions for proportioning and manipulation shall accompany each package ( see 3.9 ).

4.3 **Marking** — Each container shall be securely closed and shall bear legibly and indelibly the following information:

a) Name and type of the material;

b) Name of the manufacturer and his recognized trade-mark, if any;

c) Net mass;

d) Date of manufacture and expiry date; and

e) Batch number.

4.3.1 The containers may also be marked with the ISI Certification Mark.

NOTE — The use of the IS1 Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The IS1 Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by IS1 and operated by the producer. IS1 marked products are also continuously checked by IS1 for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

## 5. SAMPLING

**5.1** Representative test samples shall be drawn as prescribed in Appendix B or as agreed to between the purchaser and the supplier.

# APPENDIX A

## ( *Clauses* 3.3, 3.4, 3.5, 3.6, 3.7.2 *and* 3.8 )

### METHODS OF TESTS FOR DENTAL CASTING INVESTMENT FOR GOLD ALLOYS

### A-l. TEST CONDITIONS

**A-l.1** Unless specified otherwise, all tests shall be carried out at 27·0 ± 2·0°C. Equipment and material shall be conditioned at this temperature for at least 10 hours prior to testing.

### A-2. TEST FOR FINENESS

**A-2.1 Procedure-Spread** out the sample in a thin layer and dry at 45°C for 2 hours and then cool in a desiccator over anhydrous calcium sulphate containing a moisture indicator. Determine fineness by screening not less than 10 g of the dried sample through successive sieves stacked from top to bottom in this order: 600-micron, 150-micron and 75-micron, and determine the ***mass*** of the material remaining on each sieve. Brush the material through the sieve with as little abrasion as possible. Continue the operation until not more than 0·1 g passes through in 1 minute of sieving.

### A-3. DETERMINATION OF CONSISTENCY

A-3.1 Procedure — Mix the investment with sufficient distilled water, at 27·0 ± 2·0°C, to produce a mix of testing consistency, in accordance with the following directions to give a slump within the following limits:

a) Add the powder to water in a suitable mixing bowl and immediately hand spatulate for 20 seconds. The time of initial contact of powder with water shall be considered the start of mix.

b) After hand spatulation, spatulate the mixes mechanically by 100 turns of a stiff blade in approximately 15 seconds.

c) Place on a dry glass plate a cylindrical mould 50 mm long with an internal diameter of 35 mm and fill immediately after spatulation of the mix.

d) Two minutes from the time of starting the mix, lift the mould and allow the mixture to slump or spread over the plate on a vibration-free bench.

e) One minute after the mould is lifted, determine the major and minor diameters of the slumped mixture.

## A-4. DETERMINATION OF TIME OF SETTING

### A-4.1 Apparatus

**A-4.1.1** *Gillmore Initial Needle* — conforming to the following requirements:

| | |
|---|---|
| a) Mass | 110 ± 0·5 g |
| b) Diameter | 2·10 ± 0·05 mm |

The needle tip shall be cylindrical for a distance of approximately 5 mm. The needle end shall be plane and at right angles to the axis of the rod and shall be maintained in a clean condition.

A-4.1.2 *Metal Ring Mould* — cylindrical, of internal diameter 25 mm and height 25 mm.

A-4.2 **Procedure** — Carry out the test in triplicate. Place the ring mould on a flat glass plate and fill it with a mix of testing consistency ( see A-3.1 ) using 100 g of the sample. Carefully lower vertically the Gillmore needle on to the surface of the mix and allow to rest thereon under its own mass. Repeat this at frequent intervals. The mix shall be taken to have completed its set when the needle no longer penetrates to the bottom of the mould. Record the time from the moment of first contact of the sample with water to the nearest ½ minute.

A-4.2.1 Report the setting time as the mean of three determinations. If any result diverges by more than 20 percent from the mean, repeat the whole test.

## A-5. DETERMINATION OF COMPRESSIVE STRENGTH

**A-5.1 Apparatus** — Any device for the testing of compressive strength.

A-5.2 **Preparation of Test Specimens** — Use five specimens for the test. The specimens shall be cylinders, 25 to 33 mm in diameter and 50 mm high cast into split moulds, using a mix of standard consistency, set vertically on metal or glass plate. Do not cast the specimens successively but move the containing vessel back and forth over the moulds while pouring is in progress. Vibrate the moulds while pouring. Work the specimens slightly to remove air bubbles and place a second glass plate on top of the over-filled moulds and press flush with the mould end. After the specimens have become sufficiently hard to handle, remove them from the moulds. Store the specimens in air at 27 ± 2°C and relative humidity of 100 percent.

A-5.3 **Procedure** — Two hours after the commencement of the mixing procedure, determine the compressive strength of the specimens by crushing them at a loading rate of 28 kg/cm² per min. Record the mean of the

five specimens as the compressive strength, except that if the value of one or two of the specimens differs by more than 15 percent from the mean, discard those values and report the compressive strength as the mean of the remaining specimens. If the compressive strength of three or more specimens differs by more than 15 percent from the mean, discard all the results and repeat the test.

## A-6. DETERMINATION OF LINEAR EXPANSION ON SETTING

### A-6.1 **Apparatus**

**A-6.1.1** *Extensometer* — essentially as illustrated in Fig. 1, the dial gauge of which is essentially free-moving with no internal mechanism or springs which could effectively influence the expansion of the sample in the cradle. To prevent the sample mix from sticking to the sides of the cradle, grease the interior surface before use and line with thin non-absorbent paper with a glazed surface. Renew the paper lining for each test.

A-6.1.2 *Container -into* which the extensometer may be placed and stored in an atmosphere of high relative humidity. It is suggested that a plastics box with an air-tight lid, containing water to a depth of approximately 2 to 3 mm, be used, but any enclosed space which will effectively prevent dehydration of the specimen during the test may be used.

A-6.2 **Procedure** — Carry out the test in triplicate. Fill the cradle of the extensometer with a mix of standard testing consistency and strike off the level. Ensure that the movable end plate is slightly clear of the cradle and that the mix is in close contact with this plate. Three minutes before the time of setting as determined in A-4.2.1, zero the dial gauge, place the extensometer in the container ( see A-6.1.2 ), add water and close the lid. Leave undisturbed at a temperature of 27 ± 2°C for two hours measured from the first contact of the sample and water, and then take a dial reading.

### A-6.3 **Calculation and Reporting**

$$\text{Setting expansion, percent} = \frac{\text{dial reading ( in 0·01 mm )}}{100}$$

A-6.3.1 Report the setting expansion as the mean of three determinations. If any result diverges by more than 20 percent from the mean, repeat the whole test.

## A-7. DETERMINATION OF THERMAL EXPANSION

### A-7.1 **Apparatus**

**A-7.1.1** *Fused Quartz Expansion Apparatus* — shown in Fig. 2, or any other equipment of equal accuracy.

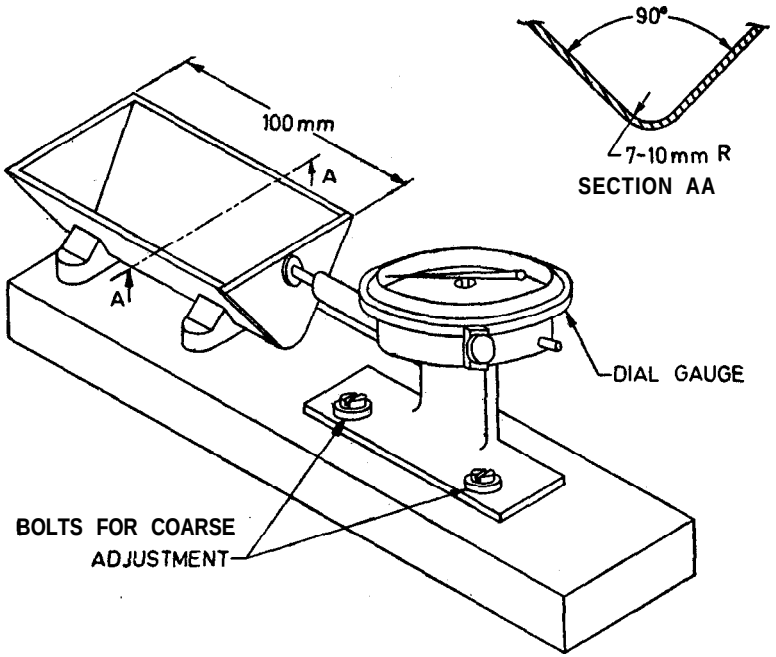



FIG. 1 EXTENSOMETER

**A-7.2 Preparation of Test Specimens** — Two cylindrical specimens, approximately 1·2 cm in diameter and 20 cm in length shall be prepared.

A-7.3 **Procedure** — Place the specimen in the expansion apparatus and heat gradually from room temperature at a rate which shall approximate the schedule given below:

| *Time* ( minutes ) | *Temperature* °C |
|---|---|
| 0 | room |
| 60 | 200 |
| 120 | 500 |
| 180 | 700 |

Take an initial observation of the length of the specimen 120 minutes from the commencement of the mixing of the sample with water. Then take observations every ten minutes. Read the change in length at a temperature of 700°C for Type I and Type III, and 500°C for Type II. Calculate the

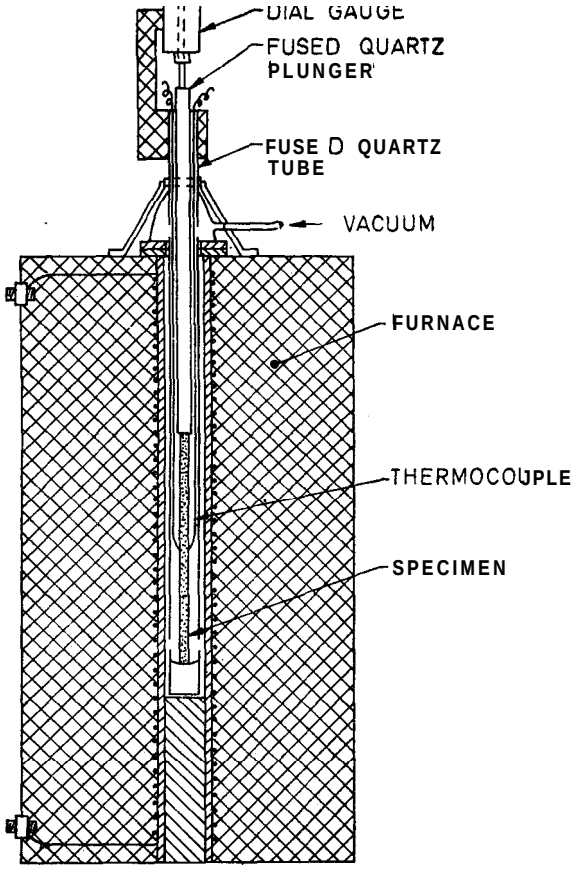


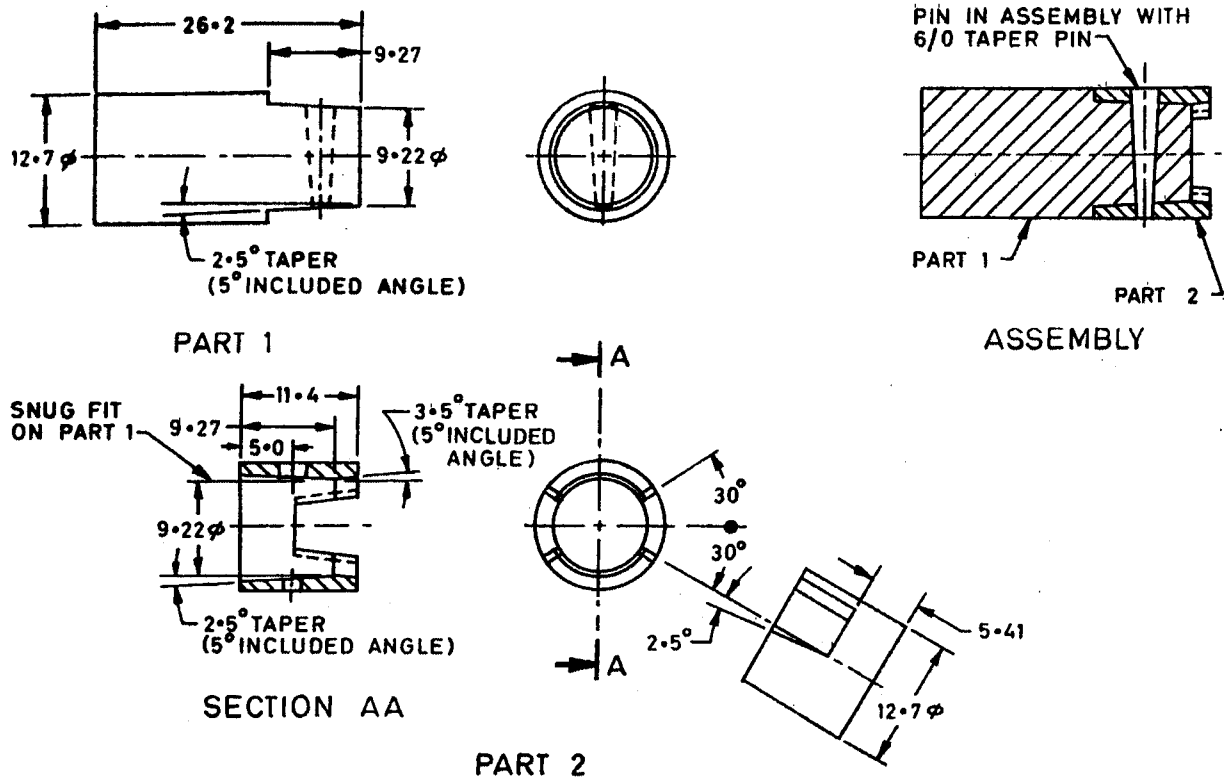

FIG. 2 FUSED QUARTZ EXPANSION APPARATUS

mean of the two observations, and if the two results are within ±0·1 percent of the mean, report it as the thermal expansion. If the results are not within that range, test two more specimens and report the mean of the four determinations.

## A-8. TEST FOR SURFACE DEFECTS OF ALLOY

### A-8.1 **Apparatus**

**A-8.1.1** *Die* — as shown in Fig. 3.




NOTE — Parts 1 and 2 shall be constructed of stainless steel.
All dimensions in millimetres.

FIG. 3 DIE

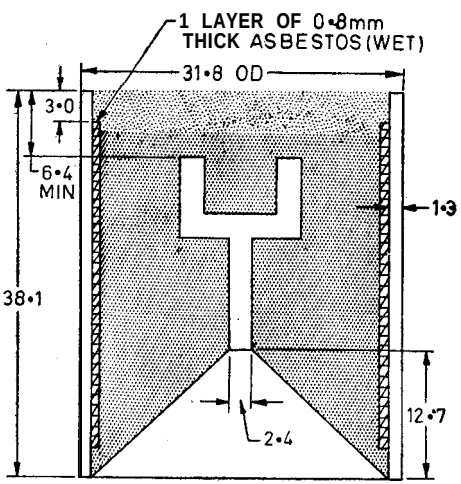
**A-8.2 Procedure** — Make a casting using the die as directed below:

a) Sprue the wax pattern in the centre of the occlusal surface and mount so that the pattern is not less than 6·4 mm from the end of the flask ( see Fig. 4 ). Make the pattern from inlay wax.

b) Invest the pattern according to manufacturer's directions.

c) One hour after investing, place the flask in the centre of the hearth of a furnace pre-heated to 425 to 485°C; then raise the temperature to the manufacturer's recommended casting temperature in 30 minutes. Hold the furnace at this temperature for 30 minutes.

d) One hour after the flask was placed in the furnace, transfer it to a casting machine of the type normally used for casting dental gold restorations and cast immediately using a 10-g mass of a Type II gold alloy ( see IS : 4799-1968*). Inspect the casting for surface contamination, pitting, fins, rough surfaces and voids.




All dimensions in millimetres.

FIG. 4 FLASK FOR CASTING

*Specification for dental casting gold alloys.

# APPENDIX B

## ( *Clause* 5.1 )

## SAMPLING OF DENTAL CASTING INVESTMENT FOR GOLD ALLOYS

### B-l. GENERAL REQUIREMENTS OF SAMPLING

**B-1.0** In drawing, preparing, storing and handling test samples, the precautions and directions given in **B-l .1** to **B-l .7** shall be observed.

**B-l.1** Samples shall not be taken in an exposed place.

**B-l.2** The sampling instrument shall be clean and dry.

B-l.3 Precautions shall be taken to protect the samples, the material being sampled, the sampling instrument and the containers for samples from adventitious contamination.

B-l.4 To draw a representative sample, the contents of each container selected for sampling shall be mixed as thoroughly as possible by suitable means.

B-1.5 The samples shall be placed in clean, dry, air-tight glass or other suitable containers.

B-l.6 The sample containers shall be of such size that they are almost completely filled by the sample.

B-l.7 Each sample container shall be sealed air-tight with a suitable stopper after filling, and marked with full details of sampling, the date of sampling and the year of manufacture of the material.

### B-2. SCALE OF SAMPLING

**B-2.1 Lot-All** the containers in a single consignment of the material drawn from a single batch of manufacture shall constitute a lot. If a consignment is declared or known to consist of different batches of manufacture the containers belonging to the same batch shall be grouped together and each such group shall constitute a separate lot.

B-2.1.1 Samples shall be tested from each lot for ascertaining conformity of the material to the requirements of this specification.

B-2.2 The number of containers to be chosen from the lot shall depend on the size of the lot and shall be as given in Table 2.

B-2.3 The containers shall be selected at random from the lot and in order to ensure the randomness of selection, the random sampling methods given in IS : 4905-1968* may be followed.

*Methods for random sampling.

**TABLE 2 NUMBER OF CONTAINERS TO BE SELECTED FOR SAMPLING**

**(*Clauses* B-2.2 and B-3.1.1 )**

| LOT SIZE | NUMBER OF CONTAINERS TO BE SELECTED |
|---|---|
| (1) | (2) |
| Up to 50 | 3 |
| 51 ,, 200 | 4 |
| 201 ,, 400 | 5 |
| 401 ,, 650 | 6 |
| 651 ,, 1000 | 7 |

## B-3. TEST SAMPLES AND REFEREE SAMPLE

### B-3.1 Preparation of Test Samples

**B-3.1.1** Draw with an appropriate sampling instrument a small portion of the material from different parts of each container selected ( see Table 2 ). The total quantity of the material drawn from each container shall be sufficient to conduct the tests for all the characteristics given under 3 and shall be not less than 250 g.

B-3.1.2 Thoroughly mix all portions of the material drawn from the same container. Out of these portions, equal quantities shall be taken from each selected container and shall be well mixed up together so as to form a composite sample weighing not less than 0·5 kg. This composite sample shall be divided into three equal parts, one for the purchaser, another for the supplier and the third for the referee.

B-3.2 Referee **Sample** — The referee sample consisting of a composite sample marked for this purpose shall bear the seal of the purchaser and the supplier. It shall be kept at a place agreed to between the purchaser and the supplier and shall be used in case of dispute between the two.

B-4. TESTS

B-4.1 Tests for all characteristics given in 3 shall be conducted on the composite sample.

B-5. CRITERIA FOR CONFORMITY

B-5.1 A lot shall be declared as conforming to this specification if the composite sample satisfies the requirements for each of the characteristics listed in 3. If the requirements for any of the characteristics are not met, the lot shall be declared to have not satisfied the requirements of the specification.

**INDIAN STANDARDS**

**ON**

**DENTAL MATERIALS AND ALLIED PRODUCTS**

IS:

3571-1966 Dental gold solders
3578-1966 Dental gold alloy wire
3610-1966 Dental gold foil
4704-1968 Silver-tin dental amalgam alloy
4705-1968 Dental mercury
4799-1968 Dental casting gold alloys
5954-1970 Dental white gold alloys
6035-1970 Zinc phosphate dental cement
6036-1970 Alginate dental impression material
6037-1970 Zinc oxide-eugenol dental impression paste
6038-1970 Dental impression compound
6039-1970 Zinc oxide-eugenol dental cement
6043-1970 Copper phosphate-zinc phosphate dental cement
6555-1972 Dental laboratory plaster
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**INDIAN STANDARDS INSTITUTION**
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110001
**Telephone : 27 01 31 ( 20 lines )** **Telegrams : Manaksanstha**

| *Branch Offices:* | Telephone |
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